

REMARKS

Claims 1 - 3, 5 - 7, 9 and 10 remain active in this application. Claims 4, 8 and 11 - 16 have previously been canceled. Amendment of claim 1 has been requested to re-insert punctuation inadvertently removed in the previous amendment and to correct verb form usage as well as to answer a criticism of claim 1 raised in the Advisory Action mailed July 7, 2005 and to complete revision of antecedent language correspondence. Support for the amendments to claim 1 is found throughout the specification and drawings, particularly in Figures 1 and 2 and the description thereof in the paragraph bridging pages 11 and 12. No new matter has been introduced into the application.

The Advisory Action Mailed July 7, 2005 notes that language deleted from claim 1 in the amendment filed December 10, 2004, remains in the copy filed June 20, 2005. While the Examiner is correct in noting that a deletion had not been reflected, the Applicant's intent was clear from the description of the amendment as reinserting punctuation inadvertently deleted previously as noted in the first paragraph of the remarks and reiterated in the first full paragraph of page 8 of that response. Accordingly, in the full listing of claims presented above, the previously deleted language has been removed. Accordingly, the corrected full listing of claims presented above is believed a full and complete response to the Examiner's observation and serves to further clarify the record in regard to the correct language of claim 1.

Claims 1 - 3 and 5 - 7 have been rejected under 35 U.S.C. §103 as being unpatentable over Colgan et al in view of Shue et al. and Uzoh (the Examiner now asserting that claims 2, 3 and 10 are product-by-process claims due to the recitation of PVD tungsten or silane based high density plasma oxide) and claims 9 -

10 have been rejected under 35 U.S.C. §103 as being unpatentable over the same combination of references in view of the further teachings of Jain. Both of these grounds of rejection are respectfully traversed for the reasons of record, hereby fully incorporated by reference, and the further remarks provided below.

It was argued in the response filed June 20, 2005, that:

"To summarize arguments previously presented, Colgan et al. is directed to control of the effects of metal migration in an environment superficially similar to that of the present invention by providing "a continuous path for copper and aluminum atoms to move in the interconnect structure" (Abstract, last sentence) and the interposition of a barrier in that path in the manner of the present invention, as claimed, would prevent that function and thus preclude operation of Colgan et al. in the intended manner. Likewise, it was previously pointed out that while Uzoh may mention the use of some of the materials recited in the present claims, Uzoh is concerned with developing a "single crystalline conductor material extending through the structure" and does so by "utilizing an *open-bottomed* via liner structure, as noted in the Abstract, column 2, line 43, and elsewhere in Uzoh. Note also in Figure 2(b) of Uzoh, layer 32 is, itself, preferably copper and has no protection applied thereto but, rather, merges with the metal of the stud 34, evidently during deposition of the stud 34 or subsequent annealing discussed at column 6, lines 12 -30, as shown in Figure 2(c). Again, like Colgan et al., the interposition

of a barrier such as by closing the bottom of the liner in the via opening would preclude the intended formation of a single crystalline structure extending through the structure. Therefore, it is respectfully submitted that neither of these references teach or suggest the claimed structure including "a multi-layer *barrier liner* in said opening...and resists interdiffusion of copper and tungsten" and any suggested modification of the structure of either reference to answer such a recitation would be improper under the precedent of *In re Gordon*, 221 USPQ 1125 (Fed. Circ., 1984), to which the Examiner's attention is respectfully called, since any such modification would clearly preclude the intended function and meritorious effect of either reference *by the very fact that, as explicitly recited, the liner presents a barrier*. It is thus irrelevant what Shue et al. may teach or suggest in regard to any possible modification of either Colgan et al. or Uzoh. Moreover, as pointed out in the previous response, the Examiner has acknowledged that the combination of Colgan et al. and Shue et al. is insufficient to answer the recitations of the claims and the combination of including Uzoh would be improper and insufficient to answer the claims for the same reason as in regard to Colgan et al. since the presence of a barrier would be as inconsistent with the intended meritorious effect of Uzoh as it is in Colgan et al.

"Further, none of these references taken singly or in any combination provides

evidence of a level of ordinary skill in the art which would support a conclusion of obviousness in regard to the subject matter of any claim in the application for the simple reason that they do not consider or even recognize the problem of attack of copper by the process materials used for the deposition of tungsten to create a via between copper and aluminum layers, much less lead to an expectation of success in obtaining a solution by the simple expedient of a multi-layer barrier layer, as claimed. Therefore, it is again respectfully submitted that the Examiner has failed to make a *prima facie* demonstration of obviousness of any claim in the application based on Colgan et al. , Uzoh and/or Shue et al.

"In this regard, the Examiner's assertion that reference to PVD tungsten" or "silane based high density plasma oxide" renders dependent claims to be product-by-process claims, in particular, is respectfully traversed. Even if (*arguendo*) the Examiner's assertion were correct, it would not reduce the Examiner's burden of making a *prima facie* demonstration of anticipation or obviousness or shift the burden of proving differences therefrom to the Applicant in regard to independent claim 1 or other claims. Further, it is respectfully submitted to be well-established that materials deposited by different techniques often have different properties (e.g. different dielectric constant, different etch or diffusion rates, different densities and the like due, for example, to different grain structures) and, where that

is the case, the method of developing such different materials *is commonly used as the name of the material*, as is respectfully submitted to be the case here. Therefore, it is respectfully submitted that the mention of PVD or a precursor material in an adjectival usage does not substantively or necessarily refer to a process at all, much less, by such a reference, alone, cause a claim to become a product-by-process claim, especially where the clear intent is to recite a material which is distinct from other materials which may be compositionally the same but formed by different processes. That such is the case logically follows from the recognition in the art of the differences in properties due to different processes which *ab initio* satisfies the burden of showing differences which is the underlying rationale for special treatment of product-by-process claims where such recognition in the art of such differences is not presented.

"In regard to Jain, it is respectfully pointed out that the Examiner relies upon Jain merely for the showing of a covering layer. However, the Examiner does not assert that Jain mitigates any of the deficiencies or improprieties of the combination of Colgan et al., Uzoh and Shue et al. discussed above. Therefore, the inclusion of Jain in regard to claims 9 and 10 does not correct the Examiner's failure to make a *prima facie* demonstration of obviousness in regard to the overall combination recited in these claim.

"Accordingly, it is respectfully submitted that the grounds of rejection which the Examiner continues to assert are in error

and untenable. In response to the Examiner's comments on remarks previously presented, it is respectfully submitted that the recognition of another advantage flowing naturally from following the suggestion of the prior art has nothing whatsoever to do with the impropriety of the combination of teachings as discussed above. The precedent of *In re Gordon, supra*, is basically a recognition that where the intended function of the prior art is precluded by the subject matter claimed in combination, any recognition of another advantage would not, in fact, flow naturally therefrom (but, rather, be unexpected and thus unobvious) and that there could be no motivation in the prior art but only through hindsight since intended functions and effects would be lost without leading to an expectation of any other meritorious effect such as that achieved and supported by the invention, as claimed. Therefore, reconsideration and withdrawal of the grounds of rejection of record are respectfully requested."

In the Advisory Action, the Examiner indicated that the above remarks arguing that the invention as claimed presented barriers which were inconsistent with and antithetical to the prior art applied were not persuasive since the claims did not preclude an open bottomed via liner. Such a construction by the Examiner is respectfully traversed as incorrect since the liner is uniformly recited as forming a "barrier liner" which would not be descriptive of a structure having an opening therein. Moreover, claim 1' also recites that the first layer of a multi-layer barrier liner extends "between said patterned aluminum layer and said patterned copper layer at said location on

said patterned copper layer" (emphasis added), is of a material that has "adhesion to copper and tungsten comparable to that of tantalum or tantalum nitride or titanium nitride" (emphasis added) and resists "interdiffusion of copper and tungsten" and that "one or both of said first and second layers *forming a conductive barrier to process materials which are reactive with copper*" (emphasis added). Therefore, it is respectfully submitted to be clearly and explicitly recited in the claims that the "barrier liner" must cover the exposed copper in order to form a "barrier" therefor, as recited, and, hence, the bottom of the opening extending to the copper layer and the liner can thus not be construed to include an open-bottomed liner consistent with the language of claim 1 (or any other claim dependent thereon) taken as a whole.

Nevertheless, in order to satisfy the Examiner on this point, further amendment of claim 1 has been requested above to explicitly recite in so many words that the liner extends "across said copper layer to cover a bottom of said opening". In view of this additional recitation which is completely consistent with and (only) supplementary to the previous recitations contained in the claim as finally rejected, the grounds of rejection of record are even more clearly seen to be in error and untenable as previously argued. Accordingly, in view of the Examiner's stated reason for finding the previously presented arguments to be non-persuasive (which, in any case, are incorrect and inconsistent with explicit recitations of the claims as finally rejected), it is respectfully submitted that the requested amendment should *prima facie* place the application in condition for allowance. Therefore entry of the above-requested amendment and reconsideration and allowance of the application are respectfully requested.

It is also again respectfully submitted that the

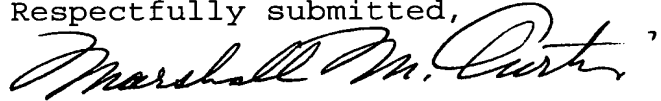
finality of the present office action is premature since neither the present office action nor the preceding office action made a *prima facie* demonstration of the propriety of the grounds of rejection contained therein. Therefore, the finality of the present action should be withdrawn and the above-requested amendments entered as a matter of right. Further, it is respectfully submitted that the above-requested amendments, at most, are directed to matters of form for which entry is provided under 37 C.F.R. §1.116, and certainly do not raise a new issue since the Examiner has clearly indicated consideration of the issue of the geometry of the liner by the Erroneous remarks in the Advisory Action. Moreover, the entry of the above-requested amendments is clearly well-justified as placing the application in condition for allowance or, in the alternative, better form for Appeal since it materially reduces issues and improves form, particularly by rendering moot the issue of propriety of the construction of the claim language asserted by the Examiner. Accordingly, entry of the above-requested amendments are respectfully submitted to be in order and such action is respectfully requested.

Since all rejections, objections and requirements contained in the outstanding official action have been fully answered and shown to be in error and/or inapplicable to the present claims, it is respectfully submitted that reconsideration is now in order under the provisions of 37 C.F.R. §1.111(b) and such reconsideration is respectfully requested. Upon reconsideration, it is also respectfully submitted that this application is in condition for allowance and such action is therefore respectfully requested.

If an extension of time is required for this response to be considered as being timely filed, a conditional petition is hereby made for such extension

of time. Please charge any deficiencies in fees and credit any overpayment of fees to Deposit Account No. 09-0458 of International Business Machines Corporation (E. Fishkill).

Respectfully submitted,

A handwritten signature in cursive script, appearing to read "Marshall M. Curtis".

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